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Research Abstracts

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CURRENT NACA REPORTS

NACA Rept. 1197

A STUDY OF THE CHARACTERISTICS OF HUMAN-PILOT CONTROL RESPONSE TO SIMULATED AIRCRAFT LATERAL MOTIONS. Donald C. Cheatham. 1954. ii, 14p. diagrs., photos., tab. (NACA Rept. 1197. Formerly RM L52C17)

There are presented studies of the characteristics of pilot ability to control dynamically unstable yawing oscillations, studies of pilot control response to simulated aircraft yawing motions, and studies of the feasibility of representing pilot control response in an analytical form.

NACA RM E55F28a

STATISTICAL SURVEY OF ICING DATA MEASURED ON SCHEDULED AIRLINE FLIGHTS OVER THE UNITED STATES AND CANADA FROM NOVEMBER 1951 TO JUNE 1952. Porter J. Perkins. September 1955. 44p. diagrs., photos., 2 tabs. (NACA RM E55F28a)

A statistical survey and a preliminary analysis are made in an interim report of over 600 icing encounters obtained from a continuing program sponsored by the NACA with the cooperation of the airlines. Pressure-type icing-rate meters were installed on 11 airline aircraft of various types. Icing conditions measured during scheduled operations gave relative frequencies of liquid-water content, icing rate, total ice accumulations, cloud temperatures, as well as horizontal and vertical extent of icing clouds. Liquid-water contents were higher than data from earlier research flights in layer-type clouds but slightly lower than previous data from cumulus clouds.*

NACA TM 1330

THEORY OF DYNAMIC CREEP. (K teorii dinamicheskoi polzuchesti). A. A. Predvoditelev and B. A. Smirnov. September 1955. 12p. diagr. (NACA TM 1330. Trans. from Moscow Universitet, Vestnik, v.8, no.8, 1953, p.79-86)

An analysis is given of the causes of the increase in creep under varying loads. It is suggested that the increase in creep is due to local rise in temperature over the slip planes, thus facilitating slip. A theory of dynamic creep is proposed, based on the Becker theory of the after-effect, which treats the metal as a granular structure and includes a rate factor. Comparison of the theory with experimental results is reserved for a future paper.

NACA TN 3293

CUMULATIVE FATIGUE DAMAGE OF AXIALLY LOADED ALCLAD 75S-T6 AND ALCLAD 24S-T3 ALUMINUM-ALLOY SHEET. Ira Smith, Darnley M. Howard, and Frank C. Smith, National Bureau of Standards. September 1955. 49p. diagrs., photos., 5 tabs. (NACA TN 3293)

Results are presented of cumulative-fatigue-damage tests made on 607 specimens machined from alclad 75S-T6 aluminum-alloy sheet 0.064 inch thick and 198 specimens of alclad 24S-T3 and alclad 75S-T6 aluminum-alloy sheet 0.032 inch thick. The tests of the 0.064-inch-thick specimens consisted of 35 different loading conditions and the tests of the 0.032-inch material consisted of 13 different loading conditions.

NACA TN 3294

FRICTION STUDY OF AIRCRAFT TIRE MATERIAL ON CONCRETE. W. G. Hample, Boeing Airplane Company. September 1955. 34p. diagrs., photos. (NACA TN 3294)

A systematic study was made of the variation of frictional resistance between typical tire-tread material and three concrete surfaces of different roughness at various temperatures and normal pressures. The tire-tread specimens were taken from the thickest portion of worn ten-ply tires, and the three concrete test blocks were poured from the same mix but subjected to different surface finishes. Curves are presented of the apparent coefficient of friction as a function of normal pressure.

NACA TN 3477

HYDRODYNAMIC PRESSURE DISTRIBUTIONS OBTAINED DURING A PLANING INVESTIGATION OF FIVE RELATED PRISMATIC SURFACES. Walter J. Kapryan and George M. Boyd, Jr. September 1955. 82p. diagrs., photos., 5 tabs. (NACA TN 3477)

*AVAILABLE ON LOAN ONLY.

Hydrodynamic pressure distributions have been obtained during pure planing for five related prismatic surfaces. The distributions gave integrated lifts that in almost every case were well within 10 percent of the applied load. Comparison of experiment with theory shows that existing theories will adequately predict flat-plate pressures. For the V-shaped surfaces, experiment and theory are in poor agreement. The lift and center-of-pressure data for both the flat and V-shaped surfaces are in good agreement with recent experimental and theoretical NACA research on planing surfaces.

NACA TN 3479

ANALYSIS OF THE HORIZONTAL-TAIL LOADS MEASURED IN FLIGHT ON A MULTIENGINE JET BOMBER. William S. Aiken, Jr. and Bernard Wiener. September 1955. i, 69p. diagrs., photo., 6 tabs. (NACA TN 3479)

Horizontal-tail loads were measured in gradual and abrupt longitudinal maneuvers on two configurations of a four-engine jet bomber. The results obtained have been analyzed to determine the flight values of the coefficients important in calculations of horizontal tail loads. The least-squares procedure used to determine aerodynamic tail loads from strain-gage measurements of structural tail loads which were affected by temperature is covered in detail. The effect of fuselage flexibility on the airplane motion is considered in the analysis of the abrupt-maneuver data. When possible, wind-tunnel results are compared with flight results. Some calculations of critical horizontal-tail loads beyond the range of the tests are given and compared with design loads.

NACA TN 3486

MEASUREMENTS OF TURBULENT SKIN FRICTION ON A FLAT PLATE AT TRANSONIC SPEEDS. Raimo J(aakko) Hakkinen, California Institute of Technology. September 1955. 41p. diagrs., photo., tabs. (NACA TN 3486)

The design and construction of a floating-element skin-friction balance are described. This instrument was applied to measurements of local skin friction in the turbulent boundary layer of a smooth flat plate at high-subsonic Mach numbers and supersonic Mach numbers up to 1.75. The principal difficulties which exist in comparing skin-friction coefficients at various Mach numbers are discussed.

NACA TN 3491

EXPERIMENTAL INVESTIGATION OF ECCENTRICITY RATIO, FRICTION, AND OIL FLOW OF LONG AND SHORT JOURNAL BEARINGS WITH LOAD-NUMBER CHARTS. G(eorge) B. DuBois, F(red) W. Ocvirk, and R. L. Wehe, Cornell University. September 1955. 63p. diagrs., tabs. (NACA TN 3491)

The performance of plain bearings under steady central loading are compared and summarized by single-line curves covering the range of length-diameter ratios both above and below 1. Experimental date on eccentricity ratio, friction, and oil flow for length-diameter ratios of 1, 1-1/2, and 2 are shown for comparison with earlier data for length-diameter ratios of 1/4, 1/2, and 1. The combined data provide charts of plain-bearing performance which cover the practical range of length-diameter ratio.

NACA TN 3493

DEVELOPMENT OF EQUIPMENT AND OF EXPERIMENTAL TECHNIQUES FOR COLUMN CREEP TESTS. Sharad A. Patel, Martin Bloom, Burton Erickson, Alexander Chwick and N(icholas) J(ohn) Hoff, Polytechnic Institute of Brooklyn. September 1955. 20p. diagrs., photos., tab. (NACA TN 3493)

Equipment and procedures developed for testing aluminum-alloy columns subjected to constant loads at elevated temperatures are described. Particular emphasis was put on determination of the influence of initial deviations from straightness on the critical time of the column, that is, the time necessary for the column to buckle when subjected to a constant load. Results are presented of tests of a number of 2024-T4 aluminum-alloy columns having large slenderness ratios.

NACA TN 3503

REDUCTION OF PROFILE DRAG AT SUPERSONIC VELOCITIES BY THE USE OF AIRFOIL SECTIONS HAVING A BLUNT TRAILING EDGE. Dean R. Chapman. September 1955. 29p. diagrs., photo. (NACA TN 3503. Supersedes RM A9H11)

A preliminary theoretical and experimental investigation has been made on the aerodynamic characteristics of blunt-trailing-edge airfoils at supersonic velocities. The theoretical considerations indicate that properly designed airfoils with moderately blunt trailing edges can have less profile drag, greater lift-curve slope, and a higher maximum lift-drag ratio than conventional sections. These predictions have been substantiated by experimental measurements on airfoils of 10-percent-thickness ratio at Mach numbers of 1.5 and 2.0, and at Reynolds numbers between 0.2 and 1.2 million.

NACA TN 3514

RESPONSE OF HOMOGENEOUS AND TWO-MATERIAL LAMINATED CYLINDERS TO SINUSOIDAL ENVIRONMENTAL TEMPERATURE CHANGE, WITH APPLICATIONS TO HOT-WIRE ANEMOMETRY AND THERMOCOUPLE PYROMETRY. Herman H. Lowell and Norman (A.) Patton. September 1955. ii, 143p. diagrs., tabs. (NACA TN 3514)

A theoretical investigation of the response of homogeneous and two-material laminated, infinite cylinders to sinusoidal environmental temperature and/or small heat-transfer coefficient changes was made. Generalized results are given for the cylinder consisting of a shell of high thermal conductivity and a core of low conductivity. The behavior of a number of specific platinum-fused-quartz "wires" of varying construction and diameter exposed to a representative airstream is indicated. For ratios of metal thickness to over-all radius of 0.1, response amplitude gains of about 4.5 are predicted as compared with gains of more than 10 for infinitesimal shells. For a relative shell thickness of 0.05, frequency responses of hot-wire anemometers, exposed-wire resistance thermometers, or thermocouples would be extended by at least an order of magnitude. Simplified analyses are included which are not exact but are adequate for design use.

NACA TN 3522

MEASUREMENTS OF THE EFFECTS OF FINITE SPAN ON THE PRESSURE DISTRIBUTION OVER DOUBLE-WEDGE WINGS AT MACH NUMBERS NEAR SHOCK ATTACHMENT. Walter G. Vincenti. September 1955. 50p. diagrs. (NACA TN 3522)

Results are presented of measurements at low supersonic speeds of the pressure distribution on two wings having a common double-wedge section and aspect ratios 2 and 4. Comparable results for aspect ratio infinity have been published in NACA TN 3225. The results cover the Mach number range from 1.166 to 1.377, which brackets the value (1.221) for bow-wave attachment at zero angle of attack. The data are discussed and compared with the previous two-dimensional findings.

NACA TN 3523

THE EFFECTIVENESS OF WING VORTEX GENERATORS IN IMPROVING THE MANEUVERING CHARACTERISTICS OF A SWEPT-WING AIRPLANE AT TRANSONIC SPEEDS. Norman M. McFadden, George A. Rathert, Jr., and Richard S. Bray. September 1955. 43p. diagrs., photos., tab. (NACA TN 3523. Supersedes RM A51J18)

The effects of wing vortex generators, multiple boundary-layer fences, and extension of the outer two segments of the wing leading-edge slats on the aerodynamic characteristics of a 35° swept-wing fighter were measured in flight tests at transonic speeds and high altitudes. Significant improvements were obtained in the pitch-up and wing-dropping-tendency characteristics with certain arrnagements of vortex generators.

NACA TN 3562

VARIATION OF BOUNDARY-LAYER TRANSITION WITH HEAT TRANSFER ON TWO BODIES OF REVOLUTION AT A MACH NUMBER OF 3.12. John R. Jack and N. S. Diaconis. September 1955. 16p. diagrs., photos. (NACA TN 3562)

Cooling a cone-cylinder model to a wall-to-free-stream ratio of approximately 1.4 increased the transition Reynolds number from a value of 2.0 x 10^{6} at equilibrium to 10.6 x 10^{6}. For temperature ratios less than 1.4, the boundary-layer flow was entirely laminar. For a parabolic-nosed body, the transition Reynolds number was about twice that of the cone-cylinder model over the temperature range investigated.

NACA TN 3563

HEAT LOSS FROM YAWED HOT WIRES AT SUBSONIC MACH NUMBERS. Virgil A. Sandborn and James C. Laurence. September 1955. 44p. diagrs., photo. (NACA TN 3563)

Heat-loss data at angles of yaw and fixed subsonic Mach numbers for several wires of different diameters commonly used in hot-wire anemometry are presented. Possible methods of correlating the data are examined. The relation of the Reynolds number normal to the flow, which has been used by most researchers, was inadequate except near a Mach number of zero. An empirical relation based on weighted addition of the heat losses of wires normal and parallel to the flow correlated all data reasonably well.

NACA TN 3566

A POLAR-COORDINATE SURVEY METHOD FOR DETERMINING JET-ENGINE COMBUSTION-CHAMBER PERFORMANCE. Robert Friedman and Edward R. Carlson. September 1955. 29p. diagrs., photo., tab. (NACA TN 3566)

An automatic polar-coordinate traversing system is described that sweeps a probe through a quarter-annular exhaust duct circumferentially at selected radial positions. With a single combined pressure and temperature probe, temperature and pressure are recorded simultaneously as a function of probe position. The use of these data in calculating temperature and flow profiles, combustion efficiency, and pressure loss is shown.

BRITISH REPORTS

N-38605*

Aeronautical Research Council (Gt. Brit.)
THE USE OF QUARTZ IN THE MANUFACTURE OF SMALL DIAMETER PITOT TUBES. J. R. Cooke. 1955. 14p. diagrs., photos., tab. (ARC CP 193)

This note describes the method of manufacture of small quartz-tipped pitot tubes (down to 0.005 in. outside tip diameter) which have been used successfully for boundary-layer measurements on small models in a supersonic wind tunnel. Tests have been made of the effects of taper and end finish on the accuracy of measurement, and of the effect of the inside diameter of the tip (for a standard taper) on response rate. For a given inside tip diameter the tapered quartz tubes gave a faster response rate than the stainless steel hypodermic tubes previously used.

N-38606*

Aeronautical Research Council (Gt. Brit.)
A NOTE ON THE SOUND FROM WEAK DISTURBANCES OF A NORMAL SHOCK WAVE. Alan Powell. 1955. 10p. diagrs. (ARC CP 194)

The disturbances of a shock wave by sound waves or temperature fluctuations are studied in one dimension to a first-order approximation. In general, both sound waves and temperature fluctuations arise behind the shock wave. Expressions are given for their amplitudes and calculated for $\gamma = 1.4$. Sound waves colliding with the shock wave are amplified, but sound waves are almost annihilated by weak shock waves if originally travelling in the same direction as the shock wave. Small temperature fluctuations give rise to much sound on an acoustical scale.

N-38607*

Aeronautical Research Council (Gt. Brit.)
REQUIREMENTS FOR UNIFORMITY OF FLOW IN SUPERSONIC WIND TUNNELS. D. E. Morris and K. G. Winter. 1955. 9p. diagr. (ARC CP 197)

An analysis is made of the effects of nonuniformity of flow on the pressure measurements on the surface of a model and also on the force and moment measurements. The following standards of flow uniformity are derived - variations in flow direction to be less than $\pm 0.1^{\circ}$ in the range $M = 1.4$ to 3; variation in Mach number to be less than ± 0.003 at $M = 1.4$ increasing to ± 0.01 at $M = 3$. A brief analysis is made of the errors in model manufacture and their effects on force and pressure measurements. Using the same standards as were used in deducing the requirements for flow uniformity quoted above, it is concluded that present standards of model manufacture are satisfactory overall, though for accurate pressure plotting tests at low supersonic Mach numbers a higher standard is desirable.

N-38608*

Aeronautical Research Council (Gt. Brit.)
A CRITERION FOR THE PREDICTION OF THE RECOVERY CHARACTERISTICS OF SPINNING AIRCRAFT. T. H. Kerr. 1955. 22p. diagrs., tabs. (ARC CP 195)

It has been deduced that the two most important parameters are the unbalanced rolling-moment coefficient about the wind axis in the spin and the ratio of pitching to rolling moment of inertia. Using the results of full-scale spinning tests on 33 aircraft, it has been possible to establish empirical relationships between the estimated unbalanced rolling-moment coefficient and the inertia ratio which effectively divide the aircraft into the three groups which have satisfactory, borderline, and unsatisfactory recovery characteristics. A simple method is presented for estimating the unbalanced rolling-moment coefficient knowing only the shape of the aircraft. The empirical relationships should give a good indication of the spin-recovery characteristics on new designs.

N-38616*

Aeronautical Research Council (Gt. Brit.)
MODEL TESTS ON THE EFFECTS OF SLIPSTREAM ON THE FLOW AT VARIOUS TAILPLANE POSITIONS ON A FOUR-ENGINED AIRCRAFT. PART I. TESTS WITH CONTRA-ROTATING PROPELLERS. D. E. Hartley, A. Spence, and D. A. Kirby. PART II. TESTS WITH SINGLE ROTATING PROPELLERS. D. A. Kirby. 1955. 37p. diagrs., tabs. (ARC R & M 2747; ARC 12,355; ARC 14,166. Supersedes RAE Aero 2322; RAE Aero 2322a)

Systematic wind-tunnel tests have been made to investigate the effects of slipstream on the flow near the tail plane of a typical civil transport with four contra-rotating propellers. Tail-plane height has been varied for each of several wing-body arrangements; only one tail plane and one propeller position have been used. This report presents the main results in the form of changes in mean downwash angle, and velocity at the tail plane, as functions of tail-plane position, lift coefficient, and propeller thrust.

N-38617*

Aeronautical Research Council (Gt. Brit.)
DETERMINATION OF THE STRESS DISTRIBUTION IN REINFORCED MONOCOQUE STRUCTURES. PART I. A THEORY OF FLAT-SIDED STRUCTURES. L. S. D. Morley. 1955. 23p. diagrs., photos. (ARC R &M 2879; ARC 14,814. Supersedes RAE Structures 120)

This paper is concerned with the estimation of the stress distribution in the neighborhood of a discontinuity in reinforced monocoque flat-sided structures. A theory is given based upon a shell model possessing uniformly distributed stringers but discrete ribs, which can serve as a basis for the practical solution of a wide range of flat-sided structures such as rectangular or polygonal fuselages and wing boxes.

N-38618*

Aeronautical Research Council (Gt. Brit.)
THE THEORETICAL WAVE DRAG OF SOME BODIES OF REVOLUTION. L. E. Fraenkel. 1955. 26p. diagrs., tab. (ARC R & M 2842; ARC 14,334. Supersedes RAE Aero 2420)

This report investigates the wave drag of bodies of revolution with pointed or open-nose forebodies and pointed or truncated afterbodies. The "quasi-cylinder" and "slender-body" theories are reviewed, a reversibility theorem is established, and the concept of the interference effect of a forebody on an afterbody is introduced. The theories are applied to bodies whose profiles are either straight or parabolic arcs, formulas and curves being given for forebody and afterbody drag, and for the interference drag. The results of the two theories are compared and are seen to agree well in the region of geometries where both theories are applicable.

N-38619*

Aeronautical Research Council (Gt. Brit.)
AN EXPERIMENTAL INVESTIGATION OF STRESS DIFFUSION IN NON-BUCKLING PLATES. L. H. Mitchell. 1955. 20p. diagrs., photos. (ARC R & M 2878. Supersedes ARC 14, 934; Strut 1540)

This report provides experimental results for comparison with theoretical analyses of stress diffusion problems. The structures considered consist of plane reinforced sheet which has been assumed not to buckle. Symmetrical loads are applied to the edge booms connected to the sheet by continuous no-slip joints. Attention is concentrated on the stress distribution near the ends of the parallel strips of plate. An outline of the existing theoretical work which is applicable to this type of problem is given. The stringer-sheet theory is compared with the photoelastic results. Some attention is also given to transverse end stiffeners which seem to have little effect on the shear stresses.

N-38620*

Aeronautical Research Council (Gt. Brit.)
THE BOUNDARY LAYER WITH DISTRIBUTED SUCTION. M. R. Head. 1955. 100p. diagrs., photos., tabs. (ARC R & M 2783. Supersedes ARC 13, 897; FM 1547; Perf. 771)

Experiments performed in flight at Reynolds numbers in the region of 3×10^6 have clearly demonstrated the stabilizing effect of small amounts of distributed suction on the laminar boundary layer. In the absence of a pressure gradient and in adverse gradients similar to those occurring on a normal airfoil, transition of the boundary layer to the turbulent form has been prevented by the use of such suction quantities as may be expected to lead to very considerable reductions in effective drag. It appears, however, that for extensive laminar flow to be achieved in this way, the surface must be free from such excrescences as would cause transition in the absence of suction.

N-38621*

Aeronautical Research Council (Gt. Brit.)
METHODS FOR CALCULATING THE LIFT DISTRIBUTION OF WINGS (SUBSONIC LIFTING-SURFACE THEORY). H. Multhopp. 1955. 96p. diagrs., tabs. (ARC R & M 2884; ARC 13, 439. Supersedes RAE Aero 2353)

These methods for calculating the load distribution on wings of any plan form are based on the conceptions of lifting-surface theory. Computer work time is shortened by careful choice of the positions of pivotal points, by plotting once for all those parts of the downwash integral which occur frequently and by a consequent application of approximate integration methods similar to those devised by the author for lifting-line problems. The basis of the method is to calculate the local lift and pitching moment at a number of chordwise sections from a set of linear equations satisfying the downwash conditions at two pivotal points in each section.

N-38711*

Aeronautical Research Council (Gt. Brit.)
SIMPLE EVALUATION OF THE THEORETICAL LIFT SLOPE AND AERODYNAMIC CENTRE OF SYMMETRICAL AEROFOILS. H. C. Garner. 1955. 20p. tabs. (ARC R & M 2847. Supersedes ARC 14,337; Perf. 847; S & C 2561)

This paper presents a simple method of calculating theoretical values of the lift slope $(a_1)_T$ and the position of aerodynamic center h_T in two-dimensional incompressible flow. Starting with the ordinates of an airfoil, the method in section 3 provides first and second approximations to both derivatives, which are compared with exact theory and other calculated values in Tables 2 and 3 for various symmetrical airfoils listed in Table 1. In section 5 a correction to the first approximation is introduced so as to permit the evaluation of $(a_1)_T$ within 1/2 percent and h_T within about 0.001 in less than a quarter of an hour. A complete illustrative calculation is set out in Table 4.

N-38712*

Aeronautical Research Council (Gt. Brit.)
BOUNDARY-LAYER CONTROL FOR HIGH LIFT BY SUCTION AT THE LEADING-EDGE OF A 40 DEG SWEPT-BACK WING. E. D. Poppleton. 1955. 38p. diagrs., tabs. (ARC R & M 2897; ARC 14,771. Supersedes RAE Aero 2440)

Wind-tunnel tests on the 10-percent-thick, constant-chord, aspect-ratio-4.6 wing are discussed. Boundary-layer control was applied along the whole leading edge; a comparison was made between the effects of distributed suction and suction through a

slot. A 45-percent Fowler flap was used in some tests. The overall effect of the two systems was similar, giving an increase in $C_{L_{max}}$ by increasing the stalling angle of attack and making the wing statically stable up to the stall, when there was a severe loss of lift. The tests were designed to determine whether leading-edge suction would produce comparable increases in $C_{L_{max}}$ on swept wings and, also whether tip stall could be prevented.

N-38713*

Aeronautical Research Council (Gt. Brit.)
ON THE APPLICATION OF OBLIQUE CO-ORDINATES TO PROBLEMS OF PLANE ELASTICITY AND SWEPT-BACK WING STRUCTURES. W. S. Hemp. WITH AN APPENDIX. S. R. Lewis. 1955. 46p. diagrs., tabs. (ARC R & M 2754; ARC 12,981. Supersedes College of Aeronautics Rept. 31; College of Aeronautics Rept. 44)

Methods are discussed by which designers can solve problems of stress distribution and deflection for the case of sweptback wing structures whose ribs lie parallel to the direction of flight. The mathematical basis is developed and formulas are derived. The results are applied to a uniform, symmetrical, rectangular section sweptback box. Theories of stress distribution and deflections are obtained for the case of loading by normal forces and couples applied to the ends of the box. The main results are then generalized to cover the case of a more representative wing structure. Functions useful in the application of the theory are given in an appendix.

N-38714*

Aeronautical Research Council (Gt. Brit.)
LOW-SPEED TUNNEL MODEL TESTS ON TAIL-PLANE ROLLING MOMENTS IN SIDESLIP. A Spence, J. W. Leathers, and D. A. Kirby. 1955. 20p. diagrs., tabs. (ARC R & M 2941; ARC 14,701. Supersedes RAE Tech. Note Aero 2123)

Measurements were made of the effect of sideslip on the rolling moment on a 41.5° sweptback tail plane mounted at three heights on the fin of a model of a single jet aircraft with a 40° sweptback wing. Incidence and tail-plane setting were varied, and the effects of rudder deflection were obtained with the tail plane at the top of the fin. Brief results on a delta aircraft model with a delta tail plane at the top of the fin are also included. Values of the rolling moment on the tail plane were obtained from measurements of the bending moment on the starboard half of the tail plane about a hinge just outside the fin.

N-38715*

Aeronautical Research Council (Gt. Brit.)
TWO-DIMENSIONAL CONTROL CHARACTERISTICS. L. W. Bryant, A. S. Halliday, and A. S. Batson. 1955. 47p. diagrs. (ARC R & M 2730. Supersedes ARC 13,039; S & C 2385; ARC 13,065; S & C 2386)

Researches on the lift, pitching moments, and hinge moments of airfoils with plain flaps have been carried out at the National Physical Laboratory at a Reynolds number of about 10^6. The results have been presented in a generalized form, which shows promise of being applicable over a wide field. It appears that a suggestion due to Preston that the ratio of experimental lift slope ($dC_L/d\alpha = a_1$) to the theoretical value $(a_1)_T$, corresponding to the Joukowsky condition of flow past the trailing edge, provides a criterion giving the combined effects of Reynolds number, transition points, and airfoil shape on $dC_L/d\alpha$, and is a very useful starting point for the estimation of control characteristics.

N-38716*

Aeronautical Research Council (Gt. Brit.)
PERMISSIBLE DESIGN VALUES AND VARIABILITY TEST FACTORS. R. J. Atkinson. 1955. 20p. diagrs., tabs. (ARC R & M 2877; ARC 11,619; ARC 13,748. Supersedes RAE Tech. Note Structures 15; RAE Tech. Note Structures 61)

For the design of structural elements it is postulated that: not more than 10 percent of any given design should have strength below the design value, and not more than 0.1 percent should have strength below 90 percent of the design value. This rule forms a working basis for the interpretation of tests on statistical lines. On the basis of a fixed probability the report deduces: expressions for the derivation of permissible design values from a given number of test results, the number of test results required so that the estimates of permissible design values can be regarded as sufficiently accurate, and the factor which should be applied to the results of tests on any number of similar components designed to meet a specified requirement.

N-38717*

Aeronautical Research Council (Gt. Brit.)
IMPROVEMENTS IN THE FATIGUE STRENGTH OF JOINTS BY THE USE OF INTERFERENCE FITS. W. A. P. Fisher and W. J. Winkworth. 1955. 17p. diagrs., photos., tabs. (ARC R & M 2874; ARC 15,014. Supersedes RAE Structures 127)

Fatigue test results are given for aluminum alloy flat bars with a single hole loaded by a pin in double shear. In one series the pin was fitted directly in the hole with various degrees of interference fit up to 0.003 in. excess diameter. The other series had a mild steel bush interposed with similar degrees of interference in the bar, but with a push fit between pin and bush. Both sets showed a great increase in fatigue strength for interference fits above a critical value.

N-38718*

Aeronautical Research Council (Gt. Brit.)
AN EXAMINATION OF THE FLOW AND PRESSURE LOSSES IN BLADE ROWS OF AXIAL-FLOW TURBINES. D. G. Ainley and G. C. R. Mathieson. 1955. 33p. diagrs. (ARC R & M 2891; ARC 14,232. Supersedes NGTE R. 86)

Available information is studied and analyzed to determine magnitudes of gas pressure losses and deflections in a wide variety of blade rows and to determine the separate influences of variables such as blade shape, blade spacing, gas Mach number, Reynolds number, incidence, etc. Special attention is paid to "secondary losses." Effects of blade tip clearance are also considered. Empirical guiding rules and charts are derived from which approximate values of the overall pressure losses and gas deflections in a range of blade rows can be deduced. It is found that secondary losses can in many instances be large, the loss being generally found to be great when the blading has low reaction.

N-38719*

Aeronautical Research Council (Gt. Brit.)
FLUTTER AND RESONANCE CHARACTERISTICS OF A MODEL CANTILEVER WING CARRYING LOCALISED MASSES. N. C. Lambourne. 1955. 25p. diagrs., tabs. (ARC R & M 2866. Supersedes: ARC 13,910; 0.939; ARC 11,008; 0.687)

Resonance tests on a model cantilever wing carrying concentrated masses were made in conjunction with flutter tests. Measurements were made with masses up to approximately five times the mass of the bare wing added at two positions. Flutter and resonance characteristics are placed in juxtaposition. An attempt is made to correlate the two sets of phenomena by means of the Küssner criterion. Distortion modes of flutter are analyzed into normal mode components. Results suggest that for a wing rigidly fixed at the root and carrying a single concentrated mass the first three normal modes are sufficient to define the flutter mode.
Copies obtainable from NACA, Washington

N-38720*

Aeronautical Research Council (Gt. Brit.)
SOME APPLICATIONS OF THE LAMÉ FUNCTION SOLUTIONS OF THE LINEARISED SUPERSONIC FLOW EQUATIONS. PART I - FINITE SWEPTBACK WINGS WITH SYMMETRICAL SECTIONS AND ROUNDED LEADING EDGES. PART II - CAMBERED AND TWISTED WINGS. G. M. Roper. 1955. 42p. diagrs. (ARC R & M 2865; ARC 14,473; ARC 14,475; ARC 14,476. Supersedes RAE Aero 2436; RAE Aero 2437)

In the present paper some special solutions are found. Some of these solutions are combined with previous solutions to give (a) pressure distribution and wave drag at zero lift on some finite unyawed sweptback wings having symmetrical sections with rounded leading edges and wing tips perpendicular to the wind direction, and (b) the change in pressure distribution and wave drag at zero lift on the surface of a Squire wing when the thickness chord ratio is modified. Some additional solutions applicable to cambered and twisted wings are also given.

N-38721*

Aeronautical Research Council (Gt. Brit.)
THE APPLICATION OF THE EXACT METHOD OF AEROFOIL DESIGN. M. B. Glauert. 1955. 45p. diagrs., tabs. (ARC R & M 2683. Supersedes ARC 10,933; FM 1161)

This report considers in detail the design of airfoils by Lighthill's exact method, in which the velocity over the airfoil surface is prescribed as a function of the angular coordinate on the circle into which the airfoil may be transformed. The mathematical basis of the method is set out, means for obtaining desired characteristics for the airfoil are developed, and the procedure to be followed in the actual design is fully discussed. Various special functions are introduced to increase the range and practical utility of the velocity distributions obtainable, and these and other functions are fully tabulated. The calculations for the design of a particular thick suction airfoil are set out in detail.
Copies obtainable from NACA, Washington

N-38722*

Aeronautical Research Council (Gt. Brit.)
AN EXPERIMENTAL INVESTIGATION OF THE BOUNDARY LAYER ON A POROUS CIRCULAR CYLINDER. D. G. Hurley and B(rian) Thwaites. 1955. 14p. diagrs., photos. (ARC R & M 2829. Supersedes ARC 14,158; FM 1584)

The report describes an experimental investigation of the boundary layer on the surface of a porous circular cylinder at which there is a normal inward velocity. The primary object of the experiments was to test the approximate theory of reference 1 for calculating the development of a laminar boundary layer under conditions of continuous suction. The formula given in that reference for calculating the momentum thickness of the layer gave results in accord with the experimental determinations. Owing to practical difficulties in the exploration of the very thin boundary layers and in the determination of the velocity gradient around the surface, other comparisons with the theory were difficult.

N-38723*

Aeronautical Research Council (Gt. Brit.)
FORMULAE FOR ESTIMATING THE FORCES IN SEAPLANE-WATER IMPACTS WITHOUT ROTATION OR CHINE IMMERSION. R. J. Monaghan and P. R. Crewe. 1955. 28p. diagrs., tabs. (ARC R & M 2804; ARC 12,399. Supersedes RAE Aero 2308)

This report contains design formulas for estimating the maximum forces, together with the times and drafts associated with these forces, in main-step landings of seaplanes provided there is neither rotation nor chine immersion. Good agreement is formed with the results of model tests made under controlled conditions at NACA. The basic formulas and curves presented are considered to be the most satisfactory and accurate of the many proposed in recent years. They involve the use of a new basic parameter which is a measure of the effect of forward velocity; a new formula for associated mass, and a new method of plotting which is considered to be the most useful for the analysis of experimental data.

N-38724*

Aeronautical Research Council (Gt. Brit.)
WIND-TUNNEL TESTS ON THE NACA 63A009 AEROFOIL WITH DISTRIBUTED SUCTION OVER THE NOSE. N. Gregory and W. S. Walker. 1955. 17p. diagrs., tabs. (ARC R & M 2900. Supersedes ARC 15,184; Perf. 987; FM 1787)

The effects of distributed suction on the stalling characteristics of the airfoil are described. The most economical extent of suction was from the leading edge for 2.75 percent chord round the upper surface. At a $R = 1.15 \times 10^6$, a suction-quantity coefficient of 0.0034 increased $C_{L_{max}}$ from 0.86 to 1.50 by delaying the stall from $\alpha = 11^o$ to $\alpha = 20^o$. Scale effect on the flow was investigated at $\alpha = 14^o$. The airfoil was also tested with a 20-percent split flap at 60^o deflection. Suction gave half the increase on the flapped airfoil that it gave on the plain airfoil. The airfoil was modified for further testing by reducing the chord and blunting the nose.

N-38725*

Aeronautical Research Council (Gt. Brit.)
DETAILED OBSERVATIONS MADE AT HIGH INCIDENCES AND AT HIGH-SUBSONIC MACH NUMBERS ON GOLDSTEIN 1442/1547 AEROFOIL. H. H. Pearcey and M. E. Faber. 1954. 52p. diagrs., photos., tabs. (ARC R & M 2849. Supersedes ARC 13,531; FM 1498; Perf. 714)

Surface-pressure distribution, shock-wave photographs, and observations of boundary-layer separation have been made over a wide range of angle of attack. The observations enable the effects of compressibility on $C_{L_{max}}$ and on the nature of the stall to be studied in detail for the two-dimensional case. The pitching-moment coefficients, also, can be integrated from the pressure distributions. Certain features of the results are thought to be of fairly general interest and application.

N-38728*

Royal Aircraft Establishment (Gt. Brit.)
TECHNIQUES FOR THE MEASUREMENT OF THE AERODYNAMIC FORCES ON OSCILLATING AEROFOILS. W. G. Molyneux. June 1955. 30p. diagrs. (RAE Tech. Note Structures 161)

The various techniques for oscillatory force measurements are considered in relation to their application to the measurement of the aerodynamic coefficients for a rectangular wing oscillating in modes of vertical translation and uniform pitch. It is shown that the eight relevant coefficients L_z, $L_{\dot{z}}$, L_α, $L_{\dot{\alpha}}$, M_z, $M_{\dot{z}}$, M_α and $M_{\dot{\alpha}}$ are obtainable by any of the techniques described. The survey is not exhaustive, but it provides a basis for comparison of the various techniques and should be of assistance to investigators in this field in indicating the particular technique most likely to meet their requirements.

N-38729*

Royal Aircraft Establishment (Gt. Brit.)
THE EFFECT OF WATER ON THE POROSITY OF PARACHUTE FABRICS. J. E. Swallow. May 1955. 18p. diagrs., tabs. (RAE Tech. Note Chem. 1248)

Air flow through parachute fabrics was found to be seriously affected by water. The porosity of the nylon, cotton, Fortisan and Terylene fabrics examined was decreased and became negligible for the closer weaves. This was mainly a surface tension effect, but swelling was a contributory factor for cellulosic fabrics. Mock-leno weave nylon fabrics were least affected.

N-38730*

Royal Aircraft Establishment (Gt. Brit.)
ON THE INTEGRAL EQUATIONS OF TWO DIMENSIONAL SUBSONIC FLUTTER DERIVATIVE THEORY. D. E. Williams. June 1955. 39p. (RAE Structures 181)

This note gives the result of an attempt to find an analytical solution of Possio's integral equation - the equation which connects the downwash and the pressure distribution on an airfoil oscillating in two-dimensional subsonic compressible flow. A method is given for solving this problem and for solving the corresponding problem in incompressible flow - the solution of Birnbaum's integral equation.

N-38732*

Royal Aircraft Establishment (Gt. Brit.)
THE DETERMINATION OF FLUORINE IN ORGANIC COMPOUNDS CONTAINING FLUORINE AND PHOSPHORUS. T. R. F. W. Fennell. May 1955. 11p. diagr., tabs. (RAE Tech. Note Chem. 1251)

A published method for the determination of fluoride in the presence of phosphate ion has been found to yield erroneous results. The method has been modified to overcome this fault.

N-38759*

Aeroplane and Armament Experimental Establishment (Gt. Brit.) THE EFFECT OF THE GROUND ON A HELICOPTER ROTOR IN FORWARD FLIGHT. I. C. Cheeseman and W. E. Bennett. July 11, 1955. 13p. diagrs. (AAEE/Res/288)

An approximate method of estimating the effect of the ground on the lift of a rotor at any forward speed is described. Flight tests on several different aircraft show reasonable agreement with the theory. Curves are given showing the relation between thrust, height, speed, and power. The theory has been extended to include the effect of a variation in blade loading and shows that within the range that this parameter takes on present single rotor helicopters the effect is small.

N-38761*

Royal Aircraft Establishment (Gt. Brit.)
A UNIFIED THEORY OF PERFECTLY PLASTIC PLATES. E. H. Mansfield. May 1955. 53p. diagrs. (RAE Structures 170)

A theory is developed for determining the collapse load and the collapse mechanism for perfectly plastic plates under normal loading. A number of solutions to simple problems is first presented and the theory is extended to deal with plates of arbitrary plan carrying a concentrated load, and to plates of rectangular or regular polygonal plan carrying a uniformly distributed load.

N-38781*

Forest Products Research Lab. (Gt. Brit.)
INVESTIGATIONS INTO GLUES AND GLUING. PROGRESS REPORT EIGHTY-FIVE - JUNE 1955. BEHAVIOR OF GLUED WOOD PRODUCTS IN LIGHT NAVAL CRAFT. PART I - SYNOPTIC REPORT. FIFTH YEAR'S ANALYSIS. R. J. Newall and L. S. Doman. 6p. (Forest Products Research Lab. Supersedes corresponding part of Progress Report 71)

This investigation consists in storing samples of plywood and other glued wood products in selected locations for periods up to 10 years. At intervals, samples are removed and systematically tested for deterioration of the glue lines, fungal attack, etc. Inspections have been made at six-monthly intervals over the past 5 years and a summary of the observations is presented.

N-38782*

Forest Products Research Lab. (Gt. Brit.)
COMPOSITE WOOD SECTION. TRIALS OF TIMBERS FOR PLYWOOD MANUFACTURE. ANINGUERIA - ANINGUERIS ALTISSIMA - UGANDA. (NO RELIABLE WEIGHT FIGURES AVAILABLE BUT PROBABLY BETWEEN 35 AND 40 LB. PER CUBIC FOOT AT 15 PER CENT MOISTURE CONTENT). (PROGRESS REPORT TWENTY-EIGHT). June 1955. 12p. tabs. (Forest Products Research Lab.)

N-38783*

Forest Products Research Lab. (Gt. Brit.)
COMPOSITE WOOD SECTION. TRIALS OF TIMBERS FOR PLYWOOD MANUFACTURE. ABURA (NZINGU)-MITRAGYNA STIPULOSA - UGANDA. (36 POUNDS PER CUBIC FOOT AT 15 PER CENT MOISTURE CONTENT). (PROGRESS REPORT TWENTY-SEVEN). June 1955. 14p. tabs. (Forest Products Research Lab.)

N-38784*

Forest Products Research Lab. (Gt. Brit.)
COMPOSITE WOOD SECTION. TRIALS OF TIMBERS FOR PLYWOOD MANUFACTURE. DAHOMA - PIPTADENIA AFRICANA - UGANDA. (47 POUNDS PER CUBIC FOOT AT 15 PER CENT CONTENT). MUCHENCHE - PIPTADENIA BUCHANANII - UGANDA. (35 POUNDS PER CUBIC FOOT AT 15 PER CENT MOISTURE CONTENT). (PROGRESS REPORT TWENTY-SIX). June 1955. 11p. tabs. (Forest Products Research Lab.)

N-38785*

Forest Products Research Lab. (Gt. Brit.)
MOISTURE RELATIONS OF COMPOSITE WOOD PRODUCTS. PROGRESS REPORT TWENTY-SEVEN - JUNE 1955. THE FURROWING OF VENEERED BLOCKBOARD. J. F. S. Carruthers. 9p. diagrs., tabs. (Forest Products Research Lab. Supersedes Progress Report 26, May, 1954)

The purpose of this investigation was to determine the cause of the furrowing which sometimes occurs on the surface of veneered blockboard after polishing. Three different core constructions were employed and an explanation of the furrowing is given for each type.

N-38807*

Royal Aircraft Establishment (Gt. Brit.)
VELOCITY CALCULATIONS BY CONFORMAL MAPPING FOR TWO-DIMENSIONAL AEROFOILS.
D. A. Spence and N. A. Routledge. February 1955. 48p. diagrs., tabs. (RAE Aero 2539)

A method is derived for computing the conformal transformation between the plane of an airfoil of arbitrary shape (symmetrical or cambered), and the plane of its velocity potential at zero lift (in which the airfoil contour becomes a slit), in order to permit calculations of the velocity at points off the surface. The integral equation which relates the contours is derived by an application of Cauchy's theorem, and solved to the order of the square of thickness ratio. The solution is found by representing the ordinate distribution by a Fourier series. The rapid tailing-off of the Fourier coefficients for all smooth airfoil shapes then leads to high accuracy being achieved with a comparatively small amount of effort. The method is straightforward and has proved easy to use.

N-38808*

Royal Aircraft Establishment (Gt. Brit.)
THE CHARACTERISTIC FREQUENCIES OF SMALL OSCILLATIONS IN THE FLOW PAST BLUFF BODIES. D. A. Spence. May 1955. 23p. diagrs. (RAE Aero 2532)

Summary: When a bluff body is placed in a steady stream it experiences buffeting, the periodicity of which can be explained in terms of interactions between external and boundary layer regions. It is shown that the frequency must satisfy a characteristic equation in order for the oscillations induced in the boundary layer to be compatible with those in the outside stream. The equation is derived formally for Lighthill's step case and for that of the circular cylinder. The Karman vortices which are observed in the latter case appear to be a consequence of the oscillatory character of the circulation around the cylinder.

DECLASSIFIED NACA REPORTS

NACA RM A54F28

ON THE RANGE OF APPLICABILITY OF THE TRANSONIC AREA RULE. John R. Spreiter. August 1954. 21p. (NACA RM A54F28) (Declassified from Confidential, 9/7/55)

Some insight into the range of applicability of the transonic area rule has been gained by comparison with the appropriate similarity rule of transonic flow theory and with experimental data for a large family of rectangular wings having NACA 63AXXX profiles.

NACA RM A54J07

THEORETICAL PRESSURE DISTRIBUTIONS FOR SOME SLENDER WING-BODY COMBINATIONS AT ZERO LIFT. Paul F. Byrd. January 1955. 39p. diagrs. (NACA RM A54J07) (Declassified from Confidential, 9/7/55)

Theoretical calculations are made of the pressure distributions for some slender, symmetrical wing-body combinations in subsonic and supersonic flow. The combinations consist first of nonlifting, sweptback wings mounted on a circular cylinder and second of such wings mounted on a body indented so that the local cross-sectional area of the combination is constant. The results indicate that indentation straightens out the isobars along the wing and diminishes the maximum perturbation velocities.

NACA RM L52H08

A STUDY OF THE ZERO-LIFT DRAG-RISE CHARACTERISTICS OF WING-BODY COMBINATIONS NEAR THE SPEED OF SOUND. Richard T. Whitcomb. September 1952. 41p. diagrs., photos., 3 tabs. (NACA RM L52H08) (Declassified from Confidential, 7/26/55)

Results are presented which indicate that near the speed of sound the zero-lift drag rise of a thin low-aspect-ratio wing-body combination is primarily dependent on the axial distribution of the cross-sectional areas normal to the airstream. Results of an investigation of applications of this concept to the reduction of the drag-rise increments of representative wing-body combinations are also presented.

NACA RM L54A29a

ON SLENDER-BODY THEORY AT TRANSONIC SPEEDS. Keith C. Harder and E. B. Klunker. March 1954. 12p. (NACA RM L54A29a) (Declassified from Confidential, 9/7/55)

The basic ideas of the slender-body approximation have been applied to the nonlinear transonic-flow equation for the velocity potential in order to obtain some of the essential features of slender-body theory at transonic speeds. The results of the investigation are presented from a unified point of view which demonstrates the similarity of slender-body solutions in the various Mach number ranges. The transonic area rule and some conditions concerning its validity follow from the analysis.